

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554**

In the Matter of)
Inquiry Regarding Carrier Current)
Systems, including Broadband over)
Power Line Systems)

ET Docket No. 03-104

REPLY COMMENTS OF
GARY W. BOX
To Comments of
POWERWAN
Dated 3 July 2003

These are Reply Comments of Gary W. Box to comments filed by POWERWAN.

The writer received a BSEE and MSEE from UCLA, 1977 and has been employed as a electrical engineer involved in the power electronics and industrial electronics industries for 29 years, mainly in product development. This experience includes numerous encounters with FCC emission requirements including designing, building and testing equipment for compliance. The writer has also been issued 9 patents and currently holds the call sign N0JCG as a member of the Amateur Radio Service.

These replies take the form of excerpts from PowerWan's original comment, noted as "Comment," followed by reply remarks, noted as "Reply". A number annotates each Comment and Reply. Replies commence immediately below.

1. COMMENT

"POWERWAN, INC believes that Access BPL would use the spectrum from 2-50 MHz. The reason for this choice is that frequency reuse of portions of this spectrum with significant data throughput would be facilitated. This would allow some ability for noise avoidance by not using some frequencies, as well as not using portions of the spectrum where other services are located, such as the amateur radio bands."

REPLY:

Of the entire electromagnetic spectrum, from DC to light, only the tiny sliver between 1 and 30 MHz is capable of unassisted, worldwide communication using little power and absolutely no infrastructure. The Amateur Radio Service, short-wave broadcast and other services demonstrate this fact daily. When the FCC was established, it was to bring order to the radio spectrum, primarily AM broadcast and HF. It has done so by establishing a licensing structure and making rules to protect those services from interference. Unlicensed operation can never be allowed to have priority or even equal footing with licensed services unless they themselves become licensed, which includes a means to identify the source of the transmission. To do otherwise would be to return to the chaos of the spark transmitter. If PowerWan avoids transmitting in just the amateur, short-wave broadcast and utility portions of the band, that would leave little spectrum for their operation and throughput will suffer accordingly.

2. COMMENT:

"Access field tests to date have not resulted in any complaints, either from the customer or from the customers' neighbors."

"To date, Access and In-house BPL has not been shown to be detrimental to radio services."

REPLY

PowerWan is apparently not aware of the tests done in Japan, Germany, Austria, England and, most recently, here in the US, all of which show substantial harmful interference from BPL transmissions. PowerWan has also chosen to take the attitude of “pollute first and see if anyone notices”. It is quite easy to conduct tests on how BPL will affect amateur radio, short-wave and other HF radio reception, but they chose instead to proceed with transmissions and wait for interference reports. It should be pointed out that the BPL tests to date in the United States have been over a controlled and very limited geographical area with no parties interested in HF communications invited to participate. The commission should rely on testing with actual receiving and transmitting equipment to determine harmful interference and not rely on interference incident reports.

3. COMMENT

“Definition of frequency bands that must be avoided or have significant signal attenuation would help, especially in particular areas such as the amateur radio bands. Notching out of particular frequency areas in an OFDM signal is routinely done. This would allow continued use of radios in these frequency bands without interference.”

REPLY

Recent tests by the American Radio Relay League (ARRL) using a conventional mobile amateur radio configuration documented substantial harmful interference from several BPL systems. PowerWan has described its BPL system as a wide band system using OFDM modulation to avoid frequencies in the amateur bands. Let’s assume that a spectrum analysis of the BPL signal shows no BPL carriers in the amateur bands. How then did the sensitive narrow bandwidth amateur receiver pick up the out of band BPL signal? If we examine the characteristics of the received noise, we see that most of the interference is a series of random ‘pops’, which one party described as sounding like a ‘Geiger counter’. They were very short, but very often, impulse noise transients. OFDM modulation creates as many as 256 (or more) discrete RF carriers and imposes a separate bit stream on each. The 256 carriers suddenly appear, transmit their bit streams, which form the packet, and then are extinguished. If the leading and trailing edges of these carriers are not controlled, the edge of each packet will look like an impulse excitation to the power line. The spectrum of an impulse is spread infinitely across the spectrum. The power line obediently reacts to this excitation as the distributed, unbalanced, resonate wire structure it is and an impulse of energy is radiated all across the HF spectrum. The phenomena would occur at every edge of every packet.

In the Amateur Radio Service this effect has been known for 80 years as “key click”. A CW (Morse code) transmitter operates by turning the carrier on and off as the key is opened and closed. In much the same way that the BPL OFDM signal turns its 256 carriers on and off at the beginning and end of the packet, although at a considerably slower rate. In CW, ‘key click’ is fixed by controlling the rise and fall times of the RF envelope, effectively passing the RF envelope through a low pass filter.

Unfortunately for BPL, passing the signal through a low pass filter will slow the baud rate substantially. OFDM works great in a band where all users are using the same modulation scheme because OFDM itself has good immunity to this effect. This is why there should be no conflict between access and in-home BPL. However, on the HF band, where the development emphasis over the last 100 years has been on raising signal to noise performance by designing ever-sharper filters and highly bandwidth conserving modulation schemes, a mode that continually generates impulse noise is incompatible.

4. COMMENT

“As is seen in many other bands, radio services are migrating to digital technology with forward error correction, with strong benefits to users including higher capacity. As the bands from 2-50 MHz are used more by digital technologies such as BPL, better utilization of these important frequencies will result. The radio services in this band will also benefit users by going from analog to digital technologies with modern modulation methodologies.”

REPLY

I repeat that the tiny sliver of frequencies between 1 and 30 MHz is the only band capable of unassisted, worldwide communication using little power and absolutely no infrastructure. As demonstrated in the aftermath of 9-11, the most modern digital technologies, all of which require extensive infrastructures, are incredibly fragile and possible to overload. No network based on a man made infrastructure can ever be as reliable as one that requires no infrastructure. I submit that the Commission reaffirm the natural uniqueness of the HF spectrum and reserve it for licensed services that focus on improving the art of spectrum efficient, minimum power applications, which is exactly what the Amateur Radio Service does. HF is not the place for wide band spread spectrum OFDM.

As much as PowerWan would like us to believe, the real electromagnetic spectrum is still analog and the simplest, most reliable, most spectrum efficient, lowest necessary power digital modulation scheme is still CW. It's also the only digital scheme that is human readable. All HF services, including the Amateur Service, have been focusing on developing efficient, bandwidth conservative digital techniques, with great success. But the focus of this development is to use the least bandwidth of the limited HF spectrum, not all of it.

5. COMMENT:

"PowerWan believes that BPL access should be treated as a service that provides better usage of existing power company assets to provide data access and other value-added services to customers who would otherwise not be able to obtain these. As such, less regulation, including an upward adjustment of Emission rules for carrier current systems to 100uV/M at 30 meters, will facilitate lowering the cost of Access BPL by lessening the need for repeaters to provide broadband in urban and especially rural areas."

REPLY

With this, and other comments, PowerWan makes it clear that they are seeking to have the Commission impose the highest possible RF emission limits on BPL technology. They are thus admitting that the power line is a poor conductor of RF and they need to increase the radiated energy level as high as possible to get sufficient conducted performance. In addition, for BPL to work at all, RF energy must be conducted along the entire path from the transmitting device to the receiving device. All parties to the NOI, including PowerWan, admit that the power line is an unbalanced system relative to RF. RF energy fed into an unbalanced system of conductors is precisely the definition of an antenna, and the entire line will radiate. The power distribution system will react the same to RF energy whether it is from noise or intentional BPL injection. The intensity of the radiation will fall off as the signal passes from line segment to line segment because a good deal of the energy is radiated. RF gain from resonance, RF mixing at junction contacts and other effects led the Commission to establish the conducted limits in 1989, which are harmonized worldwide. By raising the conducted limits the Commission would be throwing out almost 20 years of progress in suppressing unintentional HF RF emissions.

6. COMMENT

"PowerWan, INC believes the combination of utility applications and potential to provide consumer Internet/Voice services is in the best interest of the utility ratepayers and corporate shareholders. No other technology is available that leverages existing assets (utility distribution facilities) and provides enormous potential for economical customer connectivity in both rural suburban settings."

REPLY

I agree that leveraging existing utility assets is in the interest of the ratepayers and shareholders, however I disagree strongly with the statement that no other technology is available. In fact BPL is not the most economical, easiest deployed, or reliable of the choices available to the utility. I would like to remind the Commission of their recent work on establishing the Unlicensed National Information Infrastructure band at 5Ghz. The very function of Access BPL is to be part of this infrastructure. It seems only logical that the utilities also use the U-NII band for this purpose. By mounting U-NII nodes on power poles at appropriate intervals (between 1 and 10 miles), All the goals of the Commission, the utilities and even the manufacturers can be achieved without causing interference to any HF users. Perhaps more importantly, U-

NII implementations such as the Motorola Canopy system can be deployed immediately, without any further Commission action or cost to the Federal Government.

The advantages of using the U-NII band over BPL are numerous:

1. No interference to any users in HF.
2. No need for frequency notches.
3. No direct connection to power line, other than for power.
4. Independent of powerline noise.
5. Independent of powerline impedance characteristics.
6. Independent of power grid switching
7. Independent of powerline reliability, with battery backup.
8. Independent of powerline routing. Only pole location is important.
9. Freedom to configure the network as desired; either with directional antennas or omnis.
10. No safety concerns.
11. No interference liability for the utility.
12. Cheaper hardware (5Ghz transverter should be cheaper than powerline inductive components).
13. Lower radiated RF power
14. Lower power consumption overall. Could be solar powered
15. System robustness
16. FCC gets its "third wire".
17. Providing rural service is trivial.
18. Strap-on installation means neighborhoods could be "wired" in hours, not months.
19. Cheaper installation
20. Little or no rule changes needed.
21. Bandwidth is almost four times wider than BPL, leading to higher performance.

7. COMMENT

"BPL vendors, including POWERWAN, INC, have demonstrated sincere efforts to ensure that their technology, provisioned as an unintentional radiator, does not interfere with FCC regulated radio bands and will indeed meet FCC Part 15 requirements."

REPLY

FCC Part 15 requirements include the provisions that the device must not interfere with licensed services and those devices must accept any interference from licensed services. Nowhere in their comments does POWERWAN affirm these very basic precepts of Part 15 operation. This omission foreshadows the argument they may present when faced with an interference issue, which is that they meet the emission levels and must therefore be allowed to operate. I urge the Commission to specifically not allow this loophole to be available.

8. COMMENT

"In addition, FCC Order 97-Section 157 essentially places the burden on BPL opponents to justify why a new entrant or technology that may provide more affordable telecommunications to a broader base of customers, should not be approved. POWERWAN, INC asserts that heretofore arguments voiced by amateur radio forums do not meet this burden, and remain unsubstantiated and speculative without direct evidence that BPL vendors' technologies cause interference in excess of approved limitations established by the FCC guidelines."

REPLY

BPL should not be approved because the cost is too high and it is not necessary. There are three reasons why BPL should not be allowed to inject high frequency RF energy onto the power lines.

1. All BPL manufacturers and proponents, POWERWAN included, admit that to achieve adequate performance they must increase conducted RF energy levels well above the Class A limit imposed by the FCC. These limits were established and harmonized worldwide to prevent spurious RF emissions from power lines taking into account variations in lines, contact rectification and other power line anomalies. The power line doesn't distinguish between RF energy from noise and RF energy

intentionally injected from a BPL system and will respond the same to both. Allowing BPL to inject HF RF energy into the power line will negate almost 20 years of progress in preventing RF emissions from power lines. Furthermore, BPL spread spectrum and OFDM modulation schemes have been shown to inject impulse like noise onto the power lines and are thus incompatible with narrow band, licensed HF users. . Simply put; these systems will interfere with HF users.

2. All BPL equipment must have a RF receiving section, and a fairly broad one at that. The equipment will receive and respond to any RF energy in its passband including that from nearby legal HF services. Even the near field from a 5 watt amateur transmitter will saturate the front end of a BPL receiver. A perfectly legal 10 meter CW beacon at 28.25MHz running 100 watts in the typical residential backyard would render a local BPL system worthless. Simply put; legal HF users will interfere with BPL systems.
3. The entire concept of injecting high frequency RF into the power line is not necessary, and in fact has been made obsolete by the availability of the frequency allocation for the Unlicensed National Information Infrastructure at 5GHz. By the proponents' insistence that this system is intended to bring broadband Internet to the masses, BPL is part of the Unlicensed National Information Infrastructure and should use the frequency allocation set aside for that purpose. This is not a bad thing. In fact, by so declaring, the FCC will harmonize the U-NII picture and deployment can begin tomorrow with existing equipment and no additional rulemaking and no additional testing. But I suppose we can't call it BPL.